

CLAIMS

We claim:

- 1 1. A compact multi-band antenna system comprising:
 - 2 a main reflector having a shaped surface of revolution about a boresight axis
 - 3 of said antenna and being operable at a plurality of frequency bands spectrally
 - 4 offset from each other;
 - 5 a multi band feed system for said main reflector comprising a shaped non-
 - 6 linear surface of revolution about said boresight axis of said antenna and a plurality
 - 7 of feed elements;
 - 8 a first one of said feed elements installed at a first feed element location
 - 9 separated by a first gap from a vertex of said shaped non-linear surface of
 - 10 revolution on said boresight axis of said antenna, said first feed element
 - 11 illuminating said shaped non-linear surface of revolution which defines a ring-
 - 12 shaped focal point about said boresight axis for illuminating said main reflector at a
 - 13 first one of said frequency bands; and
 - 14 a second one of said feed element installed at a second feed element
 - 15 location separated from said vertex on said boresight axis by a second gap, said
 - 16 second feed element coupled to said shaped non-linear surface of revolution at a
 - 17 second one of said frequency bands to form a single coupled feed, said single
 - 18 coupled feed defining a focal ring for illuminating said main reflector at said second
 - 19 one of said frequency bands.

1 2. The compact multi-band antenna system according to claim 1 wherein said
2 first feed element is decoupled from said shaped non-linear surface of revolution.

1 3. The compact multi-band antenna system according to claim 1 wherein said
2 first feed element is further comprised of a feed aperture and said first gap is more
3 than about four wavelengths at a frequency defined within said first one of said
4 frequency bands from said vertex to said feed aperture.

1 4. The compact multi-band antenna system according to claim 1 wherein said
2 second gap is less than about two wavelengths from said vertex at a frequency
3 defined within said second one of said frequency bands.

1 5. The compact multi-band antenna system according to claim 1 wherein said
2 main reflector and said shaped non-linear surface of revolution each have no
3 continuous surface portion thereof shaped as a regular conical surface of
4 revolution.

1 6. The compact multi-band antenna system according to claim 1 wherein said
2 first one of said frequency bands is Ka-band and said second one of said frequency
3 bands is X-band.

1 7. The compact multi-band antenna system according to claim 1 wherein said
2 shaped non-linear surface of revolution is shaped to form a sub-reflector for said
3 first feed element.

1 8. The compact multi-band antenna system according to claim 1 wherein said
2 shaped non-linear surface of revolution in said single coupled feed is shaped to
3 perform as a splash plate.

1 9. The compact multi-band antenna system according to claim 1 wherein a
2 focal ring of said main reflector is about the same diameter as said shaped non-
3 linear surface of revolution.

1 10. The compact multi-band antenna system according to claim 9 wherein a
2 diameter of said shaped nonlinear surface of revolution has a diameter which is no
3 more than about 150% the diameter of said second feed element.

1 11. The compact multi-band antenna system according to claim 1 wherein said
2 single coupled feed forms a transition from a circular to radial waveguide.

1 12. A method for operating a compact multi-band antenna system comprising
2 the steps of:
3 providing a main reflector having a shaped surface of revolution about a
4 boresight axis of said antenna;

{WP126060;1}

5 forming a ring-shaped focal point about said boresight axis using a
6 subreflector in the far field relative to a first feed element aligned with said
7 boresight axis; and
8 positioning a second feed element aligned with said boresight axis in a
9 nearfield position coupled to said sub-reflector to form in combination with said
10 sub-reflector a single coupled feed, said single coupled feed defining a focal ring
11 that transforms a circular waveguide mode into a radial waveguide mode for
12 illuminating said main reflector.

1 13. The method according to claim 12 further comprising the step of forming
2 said sub-reflector as a shaped non-linear surface of revolution about said boresight
3 axis.

1 14. The method according to claim 12 further comprising the step of selecting
2 said first feed element to operate within Ka-band and said second feed element to
3 operate within X-band.

1 15. The method according to claim 12 further comprising the step of selecting
2 said first feed element to have an operating frequency spectrally offset from said
3 second feed element.

1 16. The method according to claim 12 further comprising the step of
2 concurrently operating said compact multi-band antenna on first and second
3 spectrally offset frequency bands.

1 17. The method according to claim 16 further comprising the step of positioning
2 an aperture of said first feed element spaced more than about four wavelengths
3 from a vertex of said shaped non-linear surface of revolution at a frequency within
4 said first spectrally offset frequency band.

1 18. The method according to claim 16 further comprising the step of positioning
2 an aperture of said second feed element spaced less than about two wavelengths
3 from a vertex of said shaped non-linear surface of revolution at a frequency within
4 said second spectrally offset frequency band.

1 19. The method according to claim 12 further comprising the step of selecting
2 said main reflector and said subreflector to each have no continuous surface
3 portion thereof shaped as a regular conical surface of revolution.

1 20. The method according to claim 13 further comprising the step of selecting a
2 focal ring of said main reflector to be about the same size as said shaped non-linear
3 surface of revolution.

1 21. A method for feeding a compact main reflector of an RF antenna on a plurality
2 of spectrally offset frequency bands comprising the steps of:

3 forming a focal ring for a main reflector by positioning an RF source at a first
4 frequency within said first frequency band positioned in the far field relative to a
5 shaped non-linear surface of revolution so that said shaped non-linear surface of
6 revolution operates as a subreflector;

7 forming a second focal ring for said main reflector by positioning a second RF
8 source in the nearfield of said shaped non-linear surface of revolution, said second
9 RF source interacting with said shaped non-linear surface of revolution to form a
10 single feed network at said second RF frequency, said single feed network forming
11 a coupled feed focal ring for said main antenna.

1 22. The method according to claim 21 further comprising the step of
2 transforming with said single feed network a circular waveguide mode of said
3 second RF source to a radial waveguide mode.

1 23. The method according to claim 21 further comprising the step of positioning
2 said first RF source coaxial with said second RF source.